

506 E17
This is a continuation-in-part of United States application No. 09/023,037, filed February 13, 1998, now United States Patent No. 6,074,194, which is a continuation of United States application No. 08/322,032, filed October 7, 1994, now United States Patent No. 5,718,863, which is a continuation-in-part of 07/983,459, filed on November 30, 1992, now abandoned, all hereby incorporated by reference.

In the Claims:

Please replace the claims with the following clean version of the entire set of pending claims, in accordance with 37 C.F.R. § 1.121(c)(1)(i). Cancel all previous versions of any pending claim.

A marked up version showing amendments to any claims being changed is provided in one or more accompanying pages separate from this amendment in accordance with 37 C.F.R. § 1.121(c)(1)(ii). Any claim not accompanied by a marked up version has not been changed relative to the immediate prior version, except that marked up versions are not being supplied for any added or canceled claim.

1. (Twice Amended) A system for the spray forming manufacture of near net shape molds, dies and related toolings, comprising:

506 E17
a nozzle having a flow channel, said flow channel having an inlet end, an outlet end and a longitudinal axis;

a liquid reservoir in fluid communication with said nozzle flow channel, said reservoir adapted to contain a liquid material capable of forming a mold, said liquid being pressurized in a pressurized reservoir and injected from said reservoir through a conduit ending in said nozzle flow channel

between said inlet and outlet ends and proximate to said nozzle longitudinal axis;

means for flowing a high temperature atomizing gas at a flow velocity ranging from high subsonic through supersonic velocities through the nozzle flow channel from the inlet end to the outlet end to atomize the liquid injected into the flow channel into a plume of atomized droplets;

a chamber adapted to contain a quench gas having a controlled temperature and composition for controlling the in-flight cooling of the atomized droplets;

means for directing and depositing the cooled atomized droplets onto a pattern to form the mold.


2. The system of claim 1 wherein said quench gas is selected from a group consisting of nitrogen, helium, argon, oxygen, air, and combinations thereof.

3. The system of claim 1 further comprising means for independently heating the nozzle and the reservoir.

4. The system of claim 1 further comprising means for providing relative movement between the nozzle and the pattern.

5. The system of claim 1 wherein a plurality of liquid materials capable of forming a mold are injected separately into the nozzle flow channel.

6. The system of claim 1 wherein the nozzle flow channel converges to a choke portion located



between the inlet end and the outlet end, and diverges between the choke portion and the outlet end.

7. The system of claim 1 wherein the liquid material is injected into the nozzle flow channel proximate to the longitudinal axis between the inlet end and the choke portion of the flow channel.

8. The system of claim 1 wherein the liquid material is injected into the nozzle flow channel proximate to the longitudinal axis between the choke portion and the outlet end of the flow channel.

9. Cancelled.

10. Cancelled.

11. Cancelled.

12. Cancelled.

13. Cancelled.

14. Cancelled.

15. Cancelled.

16. The system of claim 1 wherein the means for injecting the liquid material into the nozzle flow channel is accomplished by pressurizing the liquid reservoir.

17. The system of claim 1 wherein the nozzle flow channel has a linear transverse cross-sectional geometry.

18. (Twice Amended) A system for the spray forming manufacture of near net shape molds, dies and related toolings, comprising:

a plurality of nozzles, each nozzle having a flow channel, each of said flow channels having an inlet end, an outlet end and a longitudinal axis;

a liquid reservoir in fluid communication with each of said nozzle flow channels, said reservoir adapted to contain a liquid material capable of forming a mold, said liquid being pressurized in a pressurized reservoir and injected from said reservoir through a conduit ending in said nozzle flow channel between said inlet and outlet ends and proximate to said nozzle longitudinal axis;

a high temperature atomizing gas at a flow velocity ranging from high subsonic through supersonic velocities through each of the nozzle flow channels from the inlet end to the outlet end to atomize the liquid injected into the flow channels into a plume of atomized droplets directed to a chamber adapted to contain a quench gas having a controlled temperature and composition for controlling the in-flight cooling of the atomized droplets;

means for directing and depositing the cooled atomized droplets onto a pattern to form the mold.

19. The system of claim 18 further comprising means for independently heating the nozzles and the reservoirs.

20. The system of claim 18 further comprising means for providing relative movement between the nozzle and the pattern.

21. The system of claim 18 wherein a plurality of liquid materials capable of forming a mold are injected separately into the nozzle flow channel.

22. The system of claim 18 wherein the nozzle flow channel converges to a choke portion located between the inlet end and the outlet end, and diverges between the choke portion and the outlet end.

23. The system of claim 22 wherein the liquid material is injected into the nozzle flow channel proximate to the longitudinal axis between the inlet end and the choke portion of the flow channel.

24. The system of claim 22 wherein the liquid material is injected into the nozzle flow channel proximate to the longitudinal axis between the choke portion and the outlet end of the flow channel.

25. Cancelled.

26. Cancelled.

27. Cancelled.

28. Cancelled.

29. Cancelled.

30. Cancelled.

31. Cancelled.

32. The system of claim 18 wherein the means for injecting the liquid material into each of the

nozzle flow channels is accomplished by pressurizing the liquid reservoir.

33. The system of claim 18 wherein each of the nozzle flow channels has a linear transverse cross-sectional geometry.

34. (Twice Amended) A system for the spray forming manufacture of near net shape molds, dies and related toolings, comprising:

a nozzle having a flow channel, said flow channel having an inlet end, an outlet end, and a longitudinal axis;

a plurality of reservoirs in separate fluid communication with said nozzle flow channel, at least one of said reservoirs adapted to contain under pressure a liquid material capable of forming a mold and injected from said reservoir through a conduit ending in said nozzle flow channel between said inlet and outlet ends and proximate to said nozzle longitudinal axis;

means for flowing a high temperature atomizing gas at a flow velocity ranging from high subsonic through supersonic velocities through the nozzle flow channel from the inlet end to the outlet end to atomize the liquid injected into the flow channel into a plume of atomized droplets directed to a chamber adapted to contain a quench gas having a controlled temperature and composition for controlling the in-flight cooling of the atomized droplets;

means for directing and depositing the cooled atomized droplets onto a pattern to form the mold.